Claims

1. A system for detecting, identifying, and locating any mechanical malfunction, which has caused, or could cause, defects in a wafer manufactured by semiconductor process and inspection machines in the course of the actual manufacturing process or in test cycles of said machines, said system comprising:
   - a test wafer, comprising a miniature electronic recording system, which comprises at least one accelerometer and circuitry for recording data that characterizes the motion of said test wafer, including fine perturbations and vibrations in its motion during its progress through and between said semiconductor process and inspection machines;
   - a computer, comprising: software for initializing and downloading recorder programs to said miniature electronic recording system before said test wafer is placed in said semiconductor process and inspection machines; software for transferring said data that characterizes the motion of said test wafer from said miniature electronic recording system to said computer; known data, which describes the "known good" behavior of a wafer during its progress through and between said semiconductor process and inspection machines; and software for detecting, identifying, and

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locating said mechanical malfunction; and

- a reader station, comprising an AC power supply, interface circuits between said test wafer and said computer, and, if necessary, a battery charger;

wherein;

- said recorder programs cause said data that characterizes the motion of said test wafer to be recorded along the entire path of said test wafer through and between said semiconductor process and inspection machines; and
- said software for detecting, identifying, and locating said mechanical malfunction detects, identifies, and locates said mechanical malfunction by comparing said recorded data that characterizes the motion of said test wafer with said known data.

2. A system according to claim 1, wherein the test wafer is selected from the group comprising:

- wafers whose surface area and, shape, thickness, and weight are essentially equal to those of standard size production wafers; and
- wafers whose surface area and shape are essentially equal to those of standard size production wafers but whose thickness and/or weight differ from those of standard size production wafers.

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3. A system according to claim 2, wherein the test wafer is made from a material selected from the group comprising:

   - silicon;
   - aluminum;
   - glass;
   - gallium arsenide;
   - ceramic material; and
   - plastic.

4. A system according to claim 1, wherein the miniature electronic recording system is attached to the test wafer by means selected from the group comprised of:

   – gluing;
   – screwing; and
   – bolting;

5. A system according to claim 1, wherein the components of the miniature electronic recording system are mounted on one or more circuit boards.

6. A system according to claim 1, wherein the miniature electronic recording system is covered by an epoxy block molded on the

wafer.

7. A system according to claim 1, wherein a thin hermetic external cover is mounted over the miniature electronic recording system and is attached to the wafer.

8. A system according to claim 7, wherein the hermetic thin casing has a thickness such that the maximum height of the electronics and cover is preferably no more than 2mm.

9. A system according to claim 7, wherein the hermetic thin casing is made of a material chosen from the group comprised of:
   - aluminum;
   - stainless steel;
   - composite materials;
   - polyurethane;
   - silicon;
   - ceramic materials; and
   - plastic.

10. A system according to claim 1, wherein the miniature electronic recording system additionally comprises components selected from the group comprised of:

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- analog-to-digital converters;
- microprocessors;
- batteries;
- memory units;
- temperature sensors;
- analog multiplexers;
- analog filters;
- peak-detectors; and
- sample-and-hold electronic circuits.

11. A system according to claim 1, wherein the accelerometers are selected from the group comprised of:
    - dual-axis accelerometers;
    - 3-axis accelerometers; and
    - piezoelectric accelerometers.

12. A system according to claim 10, wherein the analog-to-digital converter includes an analog multiplexer, which enables the digitizing of a multitude of analog signals.

13. A system according to claim 10, wherein the microprocessor includes a real-time clock and internal program memory.

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14. A system according to claim 10, wherein the battery is a rechargeable battery.

15. A system according to claim 14, wherein the rechargeable battery is a lithium polymer battery.

16. A system according to claim 10, wherein the memory unit is composed of RAM memory and/or Flash memory.

17. A system according to claim 1, wherein additional sensors are attached to the test wafer, said sensors being suitable to measure parameters selected from the group comprised of:

- temperature;
- light;
- pressure;
- air-flow;
- gas flow;
- humidity;
- clearance;
- electric field; and
- magnetic field.

18. A system according to claim 1, wherein a miniature camera is

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attached to the test wafer.

19. A system according to claim 1, wherein the miniature electronic recording system detects the motion of the test wafer to which it is attached and uses the presence or absence of said motion to switch off or wake up said electronics in order to conserve power.

20. A system according to claim 1, wherein the interface circuits of the reader station are electronic interface circuits.

21. A system according to claim 1, wherein the interface circuits of the reader station are non-contact interface circuits.

22. A system according to claim 21, wherein the non-contact interface circuits of the reader station are optical interface circuits or radio frequency interface circuits.

23. A method for using a record of the motion of a test wafer, including fine perturbations and vibrations in the motion of said wafer, during its progress through and between semiconductor process and inspection machines in the course of the actual manufacturing process or in test cycles of said machines, to detect, identify, and locate any mechanical malfunction of the

processing machine which has caused, or could cause, defects in the manufactured wafer, comprising the following steps:

- placing said test wafer on the reader station;
- initializing said test wafer;
- transferring said test wafer to said processing machine;
- operating said processing machine under normal operating conditions;
- recording, in the miniature electronic recording system mounted on said test wafer, data from at least one accelerometer, said data characterizing the motion of said test wafer;
- processing the signals from the accelerometer on said test wafer;
- returning said test wafer to said reader station;
- downloading said recorded data into a computer;
- erasing, if desired, said data recorded in said of said miniature electronic recording system; and
- detecting, identifying, and locating any mechanical malfunction of the processing machine;

wherein;

- said data that characterizes the motion of said test wafer is recorded along the entire path of said test wafer through and between said semiconductor process and inspection machines;

and

- the software of said computer detects, identifies, and locates said mechanical malfunction by comparing said recorded data characterizing the motion of said test wafer with known data previously stored in the memory of said computer.

24. A method according to claim 23, wherein initializing the test wafer includes some or all of the following steps:

- recharging a battery on said test wafer;
- downloading different versions of recording programs and/or other parameters from the computer into the memory of said test wafer; and
- initializing the real-time clock on said test wafer.

25. A method according to claim 23, wherein the signals are processed using one of the strategies selected from the group comprising:

- on-wafer signal processing followed by low sampling-rate signal digitizing; and
- high-rate signal sampling followed by computer-based signal processing.

26. A method according to claim 23, wherein the known data to

which the recorded data is compared is selected from the group comprising:

- the precise known time-schedule of events inside the processing machine; and
- "known-good" readings or "fingerprints" of signals previously recorded on the same or on similar processing machine.

27. A method according to claim 23, wherein comparing the recorded data to known data additionally comprises the use of special software for signal recognition to automatically detect and interpret "known" problems.

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